

Proposed California Phase 3 Reformulated Gasoline Regulations

December 9, 1999

California Environmental Protection Agency



Air Resources Board

Overview

- ✦ Background
- ✦ Staff proposal with proposed changes
- ✦ Effects
- ✦ Future activities
- ✦ Staff recommendation



California's Gasoline Programs

Year Adopted	Major Changes Made
1971	Reid Vapor Pressure
1975	Sulfur
1976	Lead
1990	Phase 1 RFG <ul style="list-style-type: none">- Reid Vapor Pressure- Lead Phase-Out- Deposit Control Additives
1991	Phase 2 RFG <ul style="list-style-type: none">- 8 properties, including RVP Wintertime Oxygenates
1994	Phase 2 RFG Predictive Model
1998	Remove winter oxygen requirement where not needed

Overview of CaRFG2 Program

- ✦ Implemented in Spring 1996
- ✦ Limits on the following parameters:

RVP*

Sulfur

T50

Benzene

T90

Aromatic Hydrocarbons

Olefins

Oxygen Content

* Only the summer RVP limit is fixed, at 7.0 psi

Specifications for CaRFG2 Program

	Typical Before CaRFG2	Flat Limit Standard	Cap for All Gasoline
RVP, psi	7.8	7.0	7.0
Sulfur, ppmw	150	40	80
Aromatic HC, vol%	32	25	30
Benzene, vol%	2.0	1.0	1.2
Olefins, vol%	9.9	6.0	10.0
Oxygen, wt%	0	1.8-2.2	1.8*-3.5
T90, deg F	330	300	330
T50, deg F	220	210	220

* Wintertime only

** Refinery cap = 310 deg F

Predictive Model

- ✦ Used for virtually all gasoline produced
- ✦ Predicts how exhaust emissions change when fuel properties change from flat specifications
- ✦ Provides alternative means of compliance
- ✦ Increases gasoline producer's flexibility
- ✦ Reduces compliance costs / improves production capability

Additional Emission Benefits

1998 In-Use Fuel Compared to CaRFG2 Specifications

2005 (tpd)

Pollutant	Additional Benefits
	Realized
Total Hydrocarbons (HC)	31 tpd
Oxides of Nitrogen (NOx)	32 tpd
Toxics	12%

* Based on on-road exhaust and evaporative emissions

Cost of CaRFG2

- ✦ ARB staff originally estimated CaRFG2 would add 5 to 15 cents per gallon to gasoline production costs
- ✦ In 1996, California Energy Commission estimated CaRFG2 accounted for 5-8 cents per gallon increase in price of California gasoline
- ✦ November 1999, Attorney General assessment
 - Wholesale prices for CARB gasoline has averaged about 4 cents greater than conventional gasoline

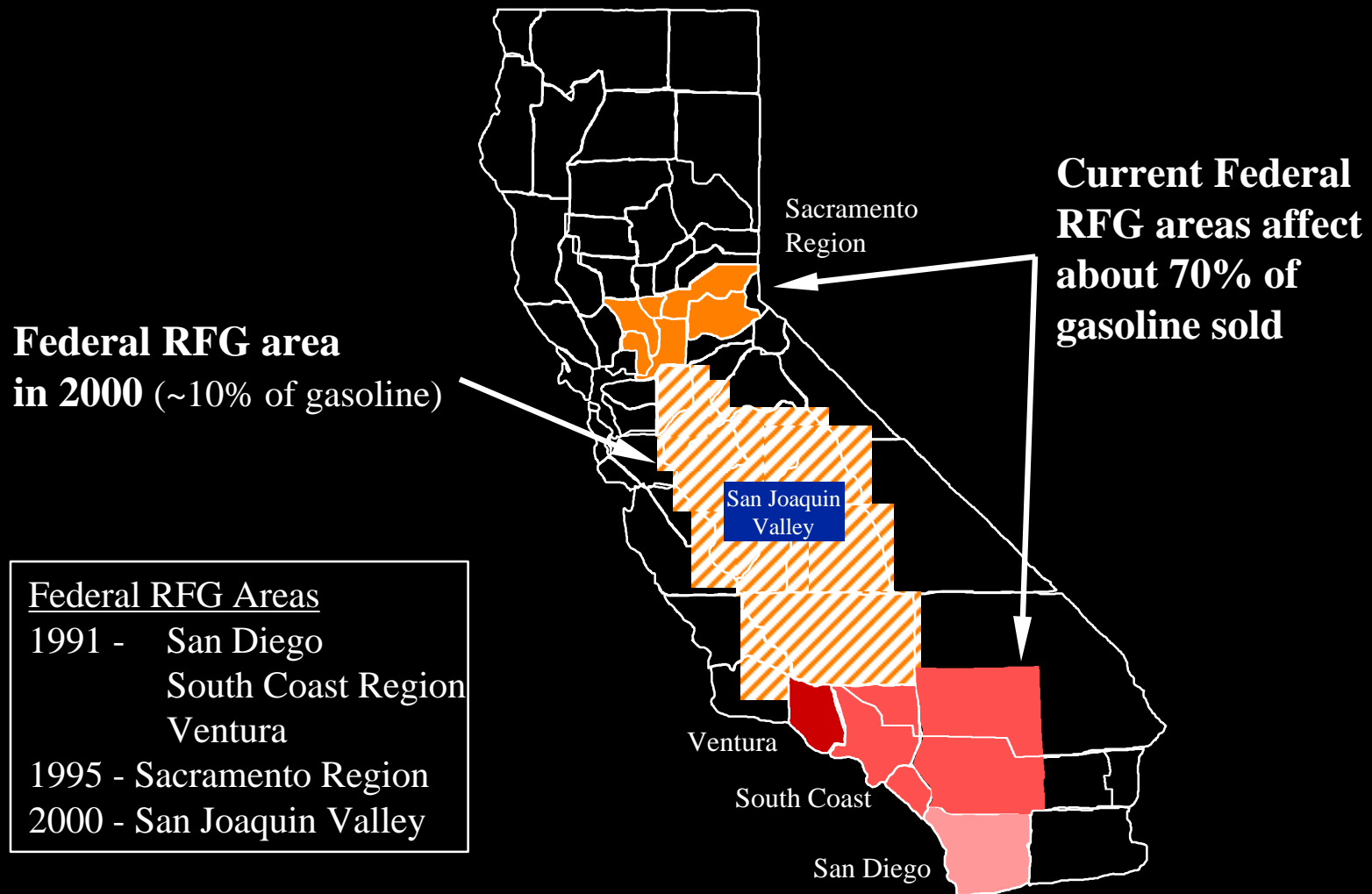
History of Oxygenate Use

- ✦ Used since late 1970's to increase octane
- ✦ Clean Air Act required oxygen in winter gasoline starting in 1992 in CO non-attainment areas
- ✦ Year-round in federal RFG areas starting in 1995 (30% of gasoline nationwide)
- ✦ MTBE refiner's primary choice

Oxygen Requirements in California

- ✦ California's rules are flexible
- ✦ Emissions benefits can be met without oxygen except in winter in the South Coast area to reduce carbon monoxide
- ✦ Federal minimum oxygen content applies to Federal RFG areas and is a year-round requirement

Federal Minimum Oxygen Requirement Affects Most of State



Governor's Executive Order



- ✦ On March 25, 1999 Governor Davis issued Executive Order D-5-99 for the phase-out of MTBE from California gasoline by earliest practical date but not later than December 31, 2002
- ✦ Directs ARB to adopt CaRFG regulations to provide additional flexibility in removing oxygen while preserving benefits
- ✦ Directs ARB to request waiver from Federal Oxygen Requirement from U.S. EPA

Other Key Directives from Executive Order D-5-99

- ✦ ARB and the SWRCB to conduct analysis of environmental fate and transport of ethanol
- ✦ OEHHA to prepare an analysis of the health risks associated with the use of ethanol
- ✦ CEC to evaluate steps to foster waste-based or other biomass ethanol development in California if ethanol acceptable substitute for MTBE

New State Legislation

- ✦ Senate Bill 989 (Sher)
 - Ensure the CaRFG3 regulations maintain or improve upon emissions and air quality benefits achieved by CaRFG2 and provide additional flexibility to reduce or remove oxygen from motor vehicle fuel
- ✦ Senate Bill 529 (Bowen)
 - Establishes a mechanism for conducting multi-media review of revisions to ARB's CaRFG standards
- ✦ Governor's Environmental Policy Council review January 18, 2000



Staff Proposal

Staff Proposal

Objective of Today's CaRFG3 Proposal

- ✦ Responsive to the Governor's Executive Order
- ✦ Remove MTBE from California gasoline
- ✦ Preserve current emission benefits
- ✦ Enable the use of ethanol without sacrificing emissions benefits
- ✦ Add flexibility to minimize loss in gasoline production due to removal of MTBE
- ✦ Accommodate need for imports on routine basis

External Process

- ✦ Phase 3 gasoline (CaRFG3)
 - Met with individual stakeholders
 - Held 9 public workshops
 - Work with California Energy Commission
- ✦ Advised by consultants from the University of California
 - Dr. Robert Sawyer, UC Berkeley
 - Dr. David Rocke, UC Davis
- ✦ Peer Review
 - Dr. Catherine Koshland, UC Berkeley
 - Dr. Donald Lucas, UC Berkeley and Lawrence Berkeley National Laboratory
 - Dr. Larry Caretto, CSU Northridge, Dean of College of Engineering

Overview of Proposed CaRFG3 Regulations

- ✦ Prohibit use of MTBE
- ✦ Change specifications to ensure benefits are preserved and to provide flexibility
- ✦ Update Predictive Model
- ✦ Evaporative emissions model added to Predictive Model
- ✦ Provide CO credit
- ✦ Increase oxygen cap for 10 percent ethanol blends
- ✦ Amend wintertime oxygenate period
- ✦ Amend the provisions (CARBOB) for ethanol blending
- ✦ Denatured ethanol specification
- ✦ Add Driveability Index requirement

Prohibition on Adding MTBE to Gasoline

- ✦ Consistent with Governor's Executive Order, effective December 31, 2002, MTBE cannot be added to gasoline
- ✦ Deminimus residual levels to be phased in

Proposed Specification Changes

- ✦ Reduce limits for sulfur and benzene to ensure benefits are preserved
- ✦ Increase limits for T50 and T90 and increase cap limit for aromatic hydrocarbons to provide flexibility
- ✦ Allow RVP to vary (6.4 to 7.2 psi.) with use of proposed evaporative model to provide flexibility

Updates to the Predictive Model

- ✦ More powerful statistics used
- ✦ Additional emissions data from nine studies included
 - About 2,500 additional data points
- ✦ New technology group added to model to reflect newer vehicles
 - 1996 to 2005 model year vehicles (“Tech 5”)
- ✦ Update weights for vehicle technology groups to reflect 2005 vehicle fleet

Evaporative Emissions Element Added to the Predictive Model

- ✦ Allows exhaust hydrocarbons and evaporative hydrocarbons trading
- ✦ Increases flexibility
- ✦ Credit for RVP reductions

Added CO Credit

- ✦ Provides credit recognizing role of CO in ozone formation

Changes to the CARBOB Provisions

- ✦ Limited changes to simplify distribution with use of ethanol
- ✦ Further changes needed
- ✦ The staff is committed to address other necessary changes next year

Extend Oxygen Cap

- ✦ Extend oxygen cap for 10 volume percent ethanol from 3.5 weight percent to 3.7 weight percent

Wintertime Oxygen Requirement for South Coast

- ✦ Remove the month of October from the wintertime oxygen season in the South Coast Air Basin starting in 2003
 - Continues to be effective November through February
 - Only 1 exceedance during October in last 4 years
- ✦ By 2003 no exceedances of the CO standard would be expected in the month of October.

Today's Amended Proposal

- ✦ Additional modifications to the fuel property limits
- ✦ Proposed small refiner provisions
- ✦ Early access to CaRFG3
- ✦ Update relative weightings for exhaust, evaporative, CO emissions, and vehicle technology groups to reflect EMFAC 2000 when adopted by the Board
- ✦ Eliminate the DI specification
- ✦ Defer setting denatured ethanol specifications until CARBOB issues are addressed

Proposed Specifications for CaRFG3

Property	Flat Limits		Averaging Limits		Cap Limits
	Original	Today	Original	Today	Original
RVP, psi	7.0 ⁽¹⁾		none		6.4-7.2
Benzene, vol%	0.80		0.70		1.10
Sulfur, ppmw	20		15		60/30 ⁽³⁾
Aromatic HC, vol%	25		22		35
Olefins, vol. %	6.0		4.0		10
Oxygen, wt. %	1.8 to 2.2		na ⁽²⁾		3.7 ⁽⁴⁾
T50 °F	211	213	201	203	225 220
T90 °F	305		295		335 330
Driveability Index ⁽⁵⁾	1225		na⁽²⁾		none

1) Equal to 6.9 psi. if using the evaporative element of the Predictive Model

2) Not Applicable

3) 60 ppmw. will apply December 31, 2002; 30 ppmw. will apply December 31, 2004

4) Allow 3.7 for gasoline containing no more than 10 volume percent ethanol

5) Driveability Index=1.5*T10+3*T50+T90+20*(wt% oxygen)

Rationale for Changes to T50 Specification

- ✦ Better information on how much cleaner in-use gasoline was than CaRFG2 specifications
- ✦ This showed that T50 could increase by 2 more degrees while still preserving benefits

Proposed Small Refiner Provision

- ✦ Only applies to small refiners that produced CaRFG2 in 1998 and 1999
- ✦ Volume cap
- ✦ Emissions increase mitigated by cleaner diesel fuel
 - Details in future rulemaking

Proposed CaRFG3 Specifications for Small Refiners

Property	Flat Limits		Cap Limits
	Large Refiners	Small Refiners	
RVP, psi	7.0 ⁽¹⁾	7.0⁽¹⁾	6.4-7.2
Benzene, vol%	0.80	1.0	1.10
Sulfur, ppmw	20	20	60/30 ⁽²⁾
Aromatic HC, vol%	25	35	35
Olefins, vol. %	6.0	6.0	10
Oxygen, wt. %	1.8 to 2.2	1.8 to 2.2	3.7 ⁽³⁾
T50 °F	213	220	220
T90 °F	305	312	330

1) Equal to 6.9 psi. if using the evaporative element of the Predictive Model

2) 60 ppmw. will apply December 31, 2002; 30 ppmw. will apply December 31, 2004

3) Allow 3.7 for gasoline containing no more than 10 volume percent ethanol

Early Access to CaRFG3

- ✦ Facilitate early MTBE removal
- ✦ Ensure continued enforceability of regulations



Update CaRFG3 Predictive Model with EMFAC 2000

- ✦ Original intent was to update the Predictive Model with EMFAC 2000
- ✦ EMFAC 2000 delayed
- ✦ Allow executive officer to adopt technical changes when EMFAC 2000 approved
 - EMFAC to be considered by Board in March 2000

Rationale for Elimination of DI Specification

- ✦ Restoration of CaRFG2 caps preserves DI
- ✦ California gasolines already have the best DI in the US
- ✦ Staff believe DI specification should be nationwide specification

Denatured Ethanol Specifications

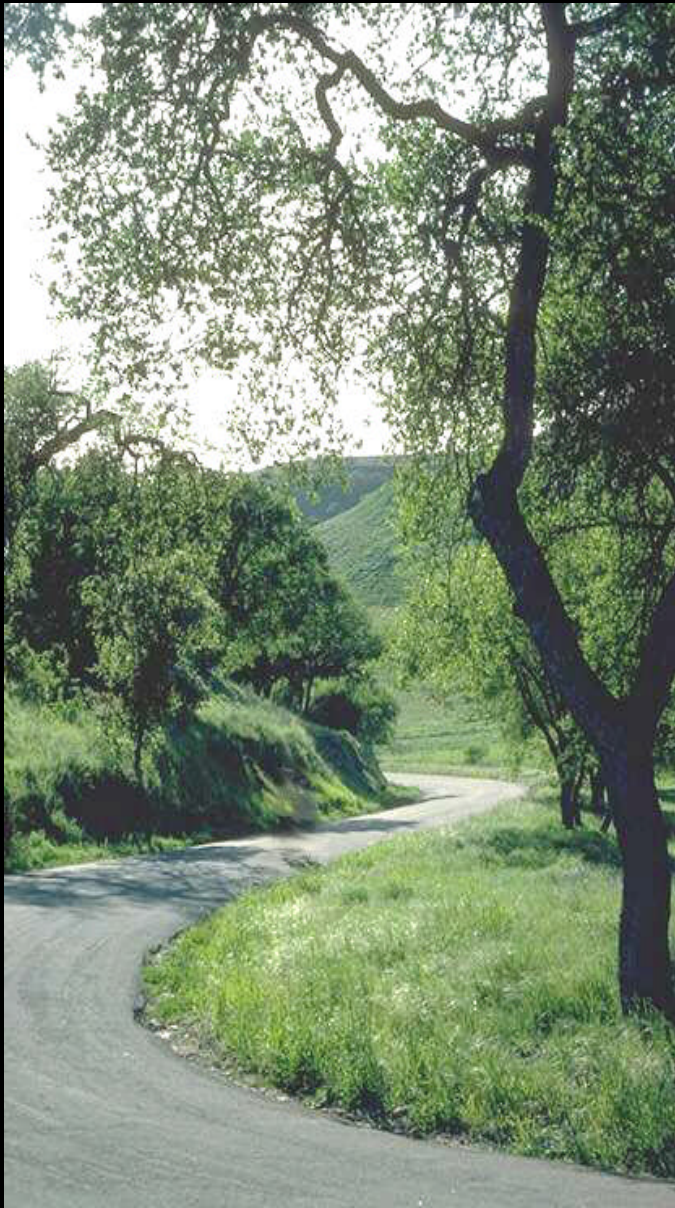
- ✦ To be considered as part of CARBOB amendments -- no later than October 2000



Effects of Today's Proposal

Overview of Effects

- ✦ Emissions
- ✦ Economics
- ✦ Production volume
- ✦ Environmental effects



Effect on Emissions

- ✦ Air Quality Objectives
 - Preserve emission benefits
 - Meets SB 989 (Sher) and Governor's Executive Order requirements

Preserving Benefits

- ✦ Determined average properties of gasoline marketed in 1998
- ✦ Determined emissions benefits achieved with 1998 in-use gasoline
- ✦ Proposed specifications so that future in-use gasoline would be required to be as clean as 1998 gasoline
- ✦ Verified proposed specifications more stringent than CaRFG2 specifications

Benefits of In-Use CaRFG2 Preserved

Pollutant	Emissions (2005)	
	Percent	tons/day
Hydrocarbon	- 0.1%	- 0.6
Oxides of Nitrogen (NOx)	- 1.2%	- 9.9
Potency Weighted Toxics	- 1.8%	na

na - not applicable

Estimated Production Cost for CaRFG3

- ✦ Estimated capital costs significantly less than \$1 billion, mostly for MTBE removal
- ✦ In October, estimates of ongoing costs were 2 to 6 cents per gallon
- ✦ Ethanol industry and at least one refiner believe actual costs will be less
- ✦ Federal oxygen waiver could reduce costs up to 2 cents per gallon
- ✦ Under right conditions costs could be zero
 - If cost of ethanol or alkylate blendstocks are less than MTBE

Environmental Impacts of CaRFG3

- ✦ MTBE contamination of existing water sources will be limited to pre-existing MTBE contamination
- ✦ Less benzene contamination of surface and ground water
- ✦ Increased ethanol use may result in slight increase in transportation emissions from rail and heavy duty trucks
- ✦ No net increase in greenhouse gas emissions
- ✦ Decreases in NO_x, potency weighted toxics and equivalency on hydrocarbon emissions

Effects on Air and Water Quality

- ✦ ARB and SWRCB are evaluating the environmental fate and transport of ethanol in air and water
- ✦ OEHHA evaluating health impacts
- ✦ To be considered by the Environmental Policy Council (January 18, 2000)



Effects of Commingling Gasoline with Ethanol and Gasoline Without Ethanol

- ✦ When gasoline with ethanol is blended with gasoline without ethanol, RVP increases
 - Results in higher evaporative emissions
 - Since Staff Report released, we have done further work to quantify
- ✦ Effect on emissions depends on various factors
 - Oxygen waiver
 - Refiner choices; mix of fuel available in given area
 - Consumer choices; brand loyalty and grade loyalty

Commingling Impacts

- ✦ The staff estimates commingling could increase average RVP by about 0.1 psi
- ✦ Proposed specifications provide cushion for commingling effects
- ✦ Propose commingling study by December 2001 to assure we have addressed commingling

Independent Peer Review of Staff's Assessment

- ✦ Followed Cal/EPA formal process for conducting peer review
 - Staff Proposal
 - Predictive Model
- ✦ Peer reviews confirm staff proposal meets objectives

Next Steps

- ✦ Use today's action to follow up on EPA oxygen waiver
- ✦ Adjust predictive model to reflect final EMFAC 2000
 - RVP and evaporative emissions relationship
 - Vehicle group weightings
- ✦ Return to Board by October 2000
 - CARBOB Amendments
 - Finalize small refiner provisions
 - Denatured ethanol specification
- ✦ Request US EPA to consider national DI specification
- ✦ Environmental Policy Council review January 18, 2000
- ✦ Initiate process to monitor refiner progress toward compliance

Next Steps (Continued)

- ✦ Conduct commingling study in 2001
- ✦ In 2004
 - Evaluate real-world CaRFG3 gasoline properties to ensure real-world benefits of CaRFG2 are preserved
 - Evaluate real-world DI levels in CaRFG3
 - Complete evaluation with CEC on impacts of near zero sulfur levels in gasoline (including impacts on supply and cost of production), and CaRFG3 in-use sulfur levels

Recommendation

- ✦ The staff recommends that the Board adopt the staff proposal as modified today to phase out MTBE and to provide refiners additional production flexibility while maintaining the emissions benefits of the existing reformulated gasoline program
- ✦ Direct staff to return before the Board no later than October 2000 to address CARBOB, denatured ethanol specifications, and small refiner provisions